

## TRAUMATIC ANEURISM OF THE LEFT SUB- CLAVIAN ARTERY PRODUCED BY FRAC- TURE OF THE CLAVICLE.

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ANEURISM of the subclavian artery, from its comparative rarity, always possesses a certain degree of interest. When that aneurism is the result of a fracture of the clavicle it becomes at once a condition of exceeding rarity; consequently, this fact renders an apology from me, for bringing the notes of the following case and some remarks on the complications of fracture of the clavicle before the readers of this journal, quite unnecessary.

M. J., a pensioner, aged sixty-two years, was admitted into the Meath Hospital under my care on October 13, 1902. His history prior to September 28, that is, until a fortnight before admission, was that of a healthy man, his only sickness being a few attacks of malaria. There was no history of syphilis, and before his accident there had never been anything wrong with the arm or shoulder.

On the evening of September 28, when stepping off a dray, he slipped and fell outward on his left shoulder. The next day, notwithstanding the fact that his shoulder was swollen and paining him considerably, he went to his work, which consisted in wheeling gravel in a wheelbarrow, but on the second day, on account of the pain, he was unable to work, and came to the Meath Hospital, where the Resident Pupil on duty treated him in the ordinary way for a fractured collar-bone. The swelling was noticed, but thought to be the result of using his arm freely for almost forty-eight hours after fracturing the clavicle.

On October 13 I saw him, and feeling pulsation, which was indeed distinctly visible in the swelling, had him admitted at once into hospital. On examination the swelling was seen to



FIG. 1.—Fracture of clavicle; wound of subclavian artery by bony spicule; traumatic aneurysm.

chiefly occupy the lower part of the left posterior triangle of the neck, but it extended forward underneath the sternomastoid muscle and downward below the clavicle, overlapping the broken fragments. It was most prominent just at the site of fracture, at which point the coverings were very thin and the pulsation more distinct. The tumor felt fairly hard all over, except just at its most prominent point, where it was soft and fluctuated distinctly. A loud bruit was easily heard all over it, and my medical colleagues were of the opinion that there was a diastolic aortic murmur. There were no evidences of any impediment to the venous return, but the patient complained of pain, tingling, and numbness down the arm and in the hand. There was no loss of power in the hand or forearm. The radial pulse on the affected side was much smaller than on the right side. There were some evidences of general atheroma, but the urine was free from albumen. My colleague, Mr. Lane Joynt, kindly took a skiagram for me (Fig. 1), which shows something of the outline of the tumor as well as the interesting condition of the broken fragments. A spiculum of bone is distinctly seen projecting downward at right angles from the inner end of the outer fragment. It was also noticed that the pulsation was not nearly so well marked in the sitting as in the recumbent position, while in the upright position it could not be detected at all, though the bruit could be heard in this position, but only faintly. The diagnosis was that of aneurism of the subclavian, produced by the spiculum of bone seen in the skiagram projecting towards the vessel.

The treatment for the next fortnight consisted in absolute rest, restricted diet, and iodide of potassium; but at the end of this time, as the aneurism was only increasing in size and threatening to rupture or suppurate (for the skin over its most prominent part and for some distance around had become red and œdematous), it was decided to endeavor to place a temporary ligature on the first stage of the subclavian, and then open the sac, turn out the clots, and deal directly with the site of the injury. To do this, an incision was made along the inner third of the clavicle as far as the sternoclavicular articulation; another incision was carried from this point upward along the inner border of the sternomastoid for about two and one-half inches, the flap thus marked out being reflected outward. With a wire saw the clavicle was divided about two inches from its inner end and the inner portion resected.

A very long, and I may say dangerous, dissection in a space full of important structures and considerably diminished by the encroachment of the now forcibly pulsating, thin-walled tumor, failed to distinctly expose the first stage of the artery. Wound of the vertebral vein, giving rise to alarming hæmorrhage for a moment or two, put an end to any further attempt to secure the artery in this stage. Gauze packing arrested the hæmorrhage from the vertebral vein. Three courses were now open to adoption. The first was to send the patient back to bed to die,—a course which certainly did not appeal to me. The second was to amputate at the shoulder-joint, and then follow up the axillary artery, and hope in this way to reach the site of injury; but I must say it did not seem to offer any bright prospect. The last was to open up the sac, turn out the clots, and make an attempt to secure the injured vessel. Before doing this, the portion of clavicle corresponding to the middle third of the bone was removed, so that direct proximal pressure might possibly be applied from without on the vessel while the clots were being turned out. The tumor was then freely incised and the clots turned out, the fingers being quickly pushed downward in the direction of the artery which was grasped by the thumb and index-finger, thus arresting the gush of blood until proximal pressure got the artery controlled. The space was then sponged clean of blood and clots, after which the artery could be easily seen lying at the bottom with a small opening in its upper and anterior aspect. The opening was of such a size as to admit a large-sized knitting-needle, and seemed to be about the middle of the third stage of the artery. There were no branches seen coming off this stage of the artery. An attempt to pass an aneurism needle round the vessel now showed the vein to be firmly adherent, and, as it was thought that any injury to the vein, necessitating its ligature also, in a patient so old and with diseased vessels, would in all probability demand amputation, a procedure which would likely be fatal, it was decided to apply forceps to the vessel. One forceps was applied external to the opening,—one over the site of the opening and one internal to it. Gauze was then passed into the space round the forceps so as to steady them. The inner part of the wound was closed with a small capillary drain in its inner angle. The shoulder and neck were enveloped in dressings and the patient put back to bed. The arm was supported on pillows

and wrapped up in warm wool. The operation lasted over two and one-quarter hours. The subsequent progress is easily told. The temperature never rose above the normal for over three weeks, when it ran up, due to an attack of malaria, but a few doses of quinine brought it down. The forceps were removed on the twelfth day, after which the wound rapidly granulated up.

The patient is now walking about quite well. I regret to say he has not yet recovered complete use of his arm, but this I attribute mainly to defective blood supply to his muscles on account of the diseased arteries. He never complained of any pain in the arm or hand subsequent to the operation, and from the time he recovered consciousness after the anæsthetic seemed to have complete sensation. Power is gradually returning, for he can now flex and extend his fingers and wrist as well as flex the forearm upon the arm.

With regard to complications attending fracture of the clavicle all authorities express but one opinion, viz., "That they are rarely, if ever, seen." It certainly seems strange that such an immunity should exist, when we reflect on the proximity of the subclavian artery and vein, the suprascapular artery, the apex of the lung, and the cords of the brachial plexus, and at the same time consider the amount of displacement of the fragments that we frequently see. So far as I have been able to learn from a perusal of the literature of this subject, any complications that have occasionally been observed have occurred chiefly in those cases in which the fracture was produced by direct violence, generally severe, such as the passage of the wheel of a cart over the shoulder, a railway smash, or due to lesions produced by a rifle-bullet. In these latter cases the complications have been attributed rather to the bullet than to the fragments of the broken bone. It has been furthermore observed that some of these cases, which were carefully examined post-mortem, had also a fracture of the first rib or upper three or four ribs, of which the first was one. The complications in these cases were mainly attributed to the fracture of the ribs and not to the fracture of the clavicle.

The neighboring nerves have been injured at the time of

the production of the fracture or have been subsequently implicated in the callus.

Stanley Boyd<sup>1</sup> makes the statement that several cases of injury to the brachial plexus have been recorded.

Jonathan Hutchinson, Sr.,<sup>2</sup> has noted hyperæmia and sometimes sweating of the same side of the head and neck, with a rise of temperature of 2° or 3° F.; injection of the conjunctiva and lachrymation; flattening of the cornea from diminished intra-ocular tension; contracted pupil and ptosis,—phenomena obviously associated with injury of the sympathetic nerve.

Gibson<sup>3</sup> reports a case of comminuted fracture in which the fragments were driven down behind the first rib, thus compressing the plexus and causing paralysis and atrophy of the whole limb.

Delens<sup>4</sup> records a case in which the superabundant callus of a fractured clavicle exerted such pressure on the subclavian vessels and nerves as to impair the nutrition and muscular power of the limb. (In this case two ribs were also broken.) Relief was afforded by resection.

Polailon<sup>5</sup> mentions briefly a case of wound of one of the nerves of the brachial plexus due to a bullet which produced fracture of the clavicle about its centre.

Jobert<sup>6</sup> relates four cases of fracture of the clavicle due to bullet wounds. In one of these a paralysis of the arm due to a lesion of the nerves of the brachial plexus was noticed. Two were uncomplicated; the other will be mentioned later under "injuries to vessels."

Stimson<sup>7</sup> says, "In a few reported cases symptoms indicating injury to the brachial plexus have appeared immediately or after an interval, and among four other cases mentions one of his own reported in the *New York Medical Journal* for June 11, 1887, in which extensive motor and sensory paralysis of the limb existed from the first, although there was no recognizable displacement.

Other cases are reported by Hassler,<sup>8</sup> Davis,<sup>9</sup> Maucelaire,<sup>10</sup> and Poirier.<sup>11</sup>

Hassler<sup>8</sup> obtained complete relief for his patient by resection of the callus.

Davis<sup>9</sup> cured his patient by correcting the displacement by operation.

Mauclaire<sup>10</sup> brought about recovery by removing a splinter of bone three weeks after the injury.

Poirier<sup>11</sup> was compelled to amputate on account of the intolerable pain in the paralyzed limb. The fracture in Poirier's case was a comminuted one and due to direct violence.

As regards injuries to the vessels, Mr. Christopher Heath<sup>12</sup>—whom I must here thank for sending me a report of his case of aneurism of the subclavian artery—details a case in which a patient was admitted under his care into University College Hospital in September, 1878, with a comminuted fracture of the left clavicle, and a simple fracture of the six upper ribs on the same side, the result of being run over by a van.

On admission, the radial pulse on the injured side was normal. He was then detained for fifteen days, during which severe bronchitis supervened. Subsequent to his discharge, he attended regularly as an out-patient, but it was not until a month after his discharge that any undue pulsation was noticed. At this time he was readmitted with a pulsating tumor occupying the lower part of the left posterior triangle of the neck and extending beneath the clavicle for a short distance. Distinct pulsation was felt over the clavicle, and a double bruit was heard, the systolic being the louder. The left radial pulse was much smaller than the right. There was some œdema of the left arm. There was no pain in the tumor, nor shooting sensations down the arm, but the arm was almost completely paralyzed. On account of the rapid increase in size of the tumor, rupture of the sac appearing likely, and the useless condition of the arm from paralysis, Mr. Heath was led to perform amputation on November 4. The wound seemed to run a favorable course, but the aneurism continued to increase until, on January 1, he introduced needles into the sac, which seemed to have the effect of leading to some consolidation in the contents. Death, however, took place on January 18, apparently from congestion of the lungs.

The autopsy showed a comminuted fracture of the clavicle about three and one-half inches from its sternal end, *i.e.*, a little to the outer side of its centre, the innermost fragment overlapping the external for quite an inch.

The fracture was firmly united, and at the lower margin, close to the communication between the artery and sac, a spiculum of bone projected. The sac of the aneurism was closely

adherent to the clavicle at the seat of fracture. The first rib was fractured close to the subclavian groove, the fracture being comminuted. The aperture of communication of the artery with the aneurism was about one and one-half inches from the thyroid axis, and measured about one-third of an inch, and was situated on the upper and anterior part of the vessel. The supra-scapular artery could not be found. The subclavian vein was adherent to the sac and impervious beyond the clavicle.

Mr. Heath in his remarks said that it was impossible that the artery could have been punctured by the comminuted clavicle, for no immediate symptoms were observed; but it seemed probable that the vessel might have been bruised or stretched by the broken first rib, and that a diseased spot in its coats might have yielded. (There was a history of syphilis.)

The aneurism was distinctly sacculated, which pointed to its traumatic origin, for spontaneous aneurisms of the subclavian are more generally fusiform.

Mr. Anthony Bowlby<sup>18</sup> has reported an extremely interesting case of injury to the subclavian artery produced by a fractured clavicle. It is that of a woman aged sixty years, who was knocked down and run over in the street, sustaining thereby a fracture of several ribs as well as a fracture of the right clavicle. On admission into St. Bartholomew's Hospital, it was noticed that in addition to the injuries already mentioned the whole of the right upper extremity was cold, white, and pulseless. This condition continued until death, which took place the next day, with the exception that the limb became warmer. There was at no time threatening of gangrene.

The autopsy showed that the right clavicle was fractured in its middle, and the first rib on the same side was broken close to its cartilage. The second part of the right subclavian artery for a distance of an inch or more was soft and flattened. On opening it, it was found that the arterial walls were healthy, and that the softened part of the artery was blocked by clot. When this was washed out, it was found that the lumen of the artery was completely occluded on the distal side of the softened area by the torn middle and internal coats, and further examination showed the following conditions: At the junction of the first and second portions of the subclavian the internal and middle coats had been cleanly divided, as if by a narrow ligature, at



right angles to the long axis of the vessels. At the cardiac side of this injury the coats had not retracted at all, nor had they curled in towards the lumen of the vessel. On the distal side, however, the inner and middle coats had been entirely stripped from the outer for a distance of more than an inch, and had been completely invaginated and thrust as a plug into the lumen of the artery beyond, so that the third part of the subclavian was plugged by the torn coats which ought to have lined the second part of the vessel, and on the rough inner surface of the second portion of the artery the blood had subsequently clotted.

Mr. Bowlby's opinion was that the artery must have been nipped up by the ends of the broken clavicle, which, being driven inward and backward, had been thrust with great violence into the vessel, in spite of the protection afforded by the scalenus anticus. He also concluded that after the division of the inner and middle coats the blood stream had made its way between the middle and external coats, and, having stripped up the former, had thrust it, together with the inner coat, into the lumen of the vessel beyond, and had thus prevented the further passage of blood along the damaged trunk.

Evans<sup>14</sup> reports a case in which an aneurism of the innominate artery was ascribed by him to a fracture of the right clavicle sustained by a patient, a sailor, many months before he came under surgical observation. The fracture was situated two inches from the sternum. Post-mortem showed inner fragment completely absorbed and sternum eroded. The probabilities are that the aneurism preceded the fracture, and may indeed have predisposed to it.

Twyman<sup>15</sup> details a peculiar case, which was that of a girl of eighteen years, who in falling off her horse struck the stump of a tree, fracturing the right clavicle at the junction of the outer and middle third. An aneurism formed, supposed to be due to the penetration of the artery by a sharp spiculum of bone. When first seen, the swelling was about half the size of a walnut and just over the artery. On admission subsequently into hospital the swelling extended for a distance of three and one-half inches, from the sternoclavicular articulation, partly overlapping the inner fragment, to a point one and one-half inches from the tip of the acromion. Upward it reached as high as the fourth cervical vertebra at a point midway between the spine and trachea.

Inward it reached sufficiently far to press upon the carotid vessels. Operation thirty-one days after the accident. The innominate was easily ligatured, being well pulled up by the tumor. The carotid was also ligatured one inch above its origin. In eighteen hours coma and death. The post-mortem showed wound of the first part of the subclavian at about one-sixth of an inch external and distal to the origin of the thyroid axis and vertebral arteries. The phrenic nerve was involved in the greatly condensed and thickened fibrous tissue forming the sac.

Ayres,<sup>16</sup> a surgeon in the United States Volunteers during the War of the Rebellion, reports the case of a scout who was shot, the ball striking the external third of the clavicle and fracturing it. The bullet passed obliquely inward and backward and emerged behind near the spinal column, having opened the right pleural cavity. A month subsequently, a severe hæmorrhage from the subclavian artery occurred, and the vessel was promptly tied in the first part of its course. The hæmorrhage ceased immediately when the ligature was drawn, but the patient sank and died in half an hour. The post-mortem showed that the bullet had fractured the clavicle in its outer third and the first rib. It then opened the pleural cavity in its course, and made its exit on the left side of the spinal column, fracturing the spines of the seventh and eighth cervical vertebræ. The hæmorrhage from the subclavian was due to a sharp spiculum of bone which had caused ulceration of the coats of the artery.

Souehon,<sup>17</sup> of New Orleans, in an exhaustive paper on "Operative Treatment of Aneurisms of the Third Portion of the Subclavian Artery," details fifteen cases of traumatic aneurism of which twelve ended fatally and three recovered. Only one of the fifteen was stated as being due to a fractured clavicle. It was that of Twyman, already referred to by me.

The subclavian vein is said to have been more frequently injured than the artery, but the following are the only cases of injury to the big vein trunks that I can find.

Most of us have heard of the late Sir Robert Peel dying from injury to the subclavian vein. The case will be found reported in the *Lancet*<sup>18</sup> of July 6, 1850. There was a comminuted fracture of the left clavicle, below which a swelling as large as the

hand could cover was found. This swelling pulsated synchronously with the contractions of the auricles of the heart. The condition was described as a "diffuse false venous aneurism." One or two of the ribs of the left side were also fractured. The late Sir John Erichsen,<sup>19</sup> then Mr. Erichsen, delivered a clinical lecture at the University College Hospital, London, on a case of "comminuted fracture of the clavicle, with compression of the subclavian vein by one of the fragments." The fracture was due to direct violence. Gangrene of the arm subsequently supervening necessitated amputation at the shoulder-joint. Death from pyæmia ended the scene. In that lecture Mr. Erichsen said, "The artery appears always to escape. I know of no case in which it has suffered if gunshot wounds be excluded." In the editions of his treatise on "Surgery," published subsequent to the delivery of this lecture, mention is made of the cases of Heath and Bowlby already detailed by me.

Manoury<sup>20</sup> records an instance of injury to the subclavian vein. In this case the extravasation extended from the cheek to the fingers, with slight pulsation and systolic bruit in the supra-clavicular region. The limb became paralyzed, and the radial pulse was lost, but reappeared on the second day. Manoury had to incise above the clavicle, but the patient died immediately from the entrance of air into the subclavian vein, which was almost torn across.

Bonne<sup>21</sup> reports a case in which a fragment from a comminuted fracture of the clavicle produced somewhat serious symptoms by pressure upon the subclavian vein and adjacent nerves.

Jobert<sup>22</sup> relates a case in which the internal jugular vein was wounded by a fractured clavicle produced by a bullet. The patient succumbed in about twenty-four hours.

Ogle<sup>23</sup> reported a case in which the internal jugular vein was wounded, the specimen being in St. George's Hospital Museum. This case was that of a youth of twenty-three years of age, who, while standing under a tree during a thunder-storm, was struck by a falling branch and died immediately. The post-mortem demonstrated the nature of the lesion to have been a tear in the right internal jugular vein, a quarter of an inch above its junction with the subclavian to form the innominate. The opening would have admitted an ordinary pea.

Polailon<sup>24</sup> said "wounds of the pleura and lung are not so

rare as wounds of the vessels," and said he knew of three examples. They were those of Vigarous, Velpeau, and Huguier.

Vigarous<sup>25</sup> was compelled to make incisions in order to relieve the embarrassment to respiration and save his patient from death. The case was that of a carrier who had his left clavicle broken by the shaft of his cart, the fracture being an oblique one. The patient in an instant felt his chest, neck, and head become rapidly inflated; his eyes became closed up, and in a short time his head, neck, chest, and trunk are said to have acquired two and a half times their normal size.

After examining the patient to discover the cause of the emphysema, Vigarous then reduced the fracture and immobilized the broken fragments, but as the emphysema instead of diminishing only went from bad to worse, a large incision was made at the bottom of the neck. In three or four days the head, neck, and upper part of the chest had almost returned to their natural state, and at the end of eight days the emphysema had entirely disappeared.

In the cases of Velpeau<sup>26</sup> and Huguier<sup>27</sup> great care was taken by these surgeons to be quite certain that there was no rib fractured, and that the infiltration of the cellular tissue with air was the result only of a wound of the lung produced by a fragment of the broken clavicle.

Gibier<sup>28</sup> reports a case in which the acromial fragment wounded the lung and produced emphysema. The patient recovered, but with non-union of the fracture.

Mercier<sup>29</sup> relates a similar case.

The only difficulty seems to be that of excluding fracture of one or more ribs which might have been the cause of the injury to the lung. In most of the cases referred to above the surgeons were not unmindful of this difficulty and seemed to have endeavored to exclude it.

While my communication up to this has been devoted entirely to complications of a serious nature produced by fracture of the clavicle, I might now, by way of contrast, be permitted to mention the following curious and remarkable case in which fracture of the clavicle was supposed, in some mysterious way, to have cured a pre-existing aneurism of the subclavian artery.

Harte,<sup>80</sup> who reports the case, gives the history as follows: "The patient about a year ago noticed at the root of his neck a large swelling which pulsated and was of considerable size. He did not seek any medical advice for this. While descending a flight of stairs he tripped and fell, striking his shoulder and fracturing his clavicle. When admitted into hospital, a large pulsating expansile mass was seen, corresponding to the position of the subclavian artery, while directly over that, and lost to a certain extent in the surrounding swelling, were the two ends of a fractured clavicle. On auscultation all the physical signs of an aneurism were evident. Shortly after admission there was considerable ecchymosis around the seat of injury, and the pulsation and bruit, with a well-marked radial pulse, still continued. Four days after the receipt of the injury, attention was called to the fact that the pulsation had entirely ceased in the region of the injury. That a clot had formed was also evident from the increased density of the tumor. No attempt was made to correct the deformity in the clavicle. The only treatment consisted in rest on his back in bed with a small sand-bag resting on his shoulder. All evidences of pulsation completely disappeared, leaving only a clavicle united with some deformity."

Dupuytren<sup>81</sup> is quoted by Stimson, Hamilton, and several others as having said he saw two or three cases of aneurism of the subclavian artery the result of a fracture of the clavicle; but on carefully reading over his lecture on aneurism I failed to see where any such mention was made, and certainly no case was described by him in any of his lectures published in book form either in the original or in the English translation.

There is a case reported by Jacquemier<sup>82</sup> in which an aneurism of the acromial branch of the acromiothoracic artery followed a fracture of the clavicle produced by direct violence.

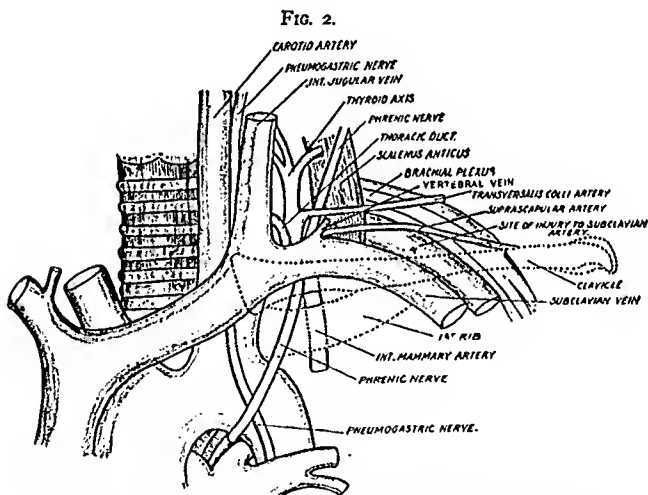
It will thus be seen that, in my perusal of the literature of this subject in both French and English, I have only been able to discover the following as complications of a fractured clavicle:

Ten authentic cases of injury (immediate or remote) to the neighboring nerves.

Four authentic cases of wounds of the subclavian artery. My own case makes the fifth.

Here I would point out that the others arose in connection with fractures produced by direct violence and all terminated fatally, whereas mine arose from a fracture produced by indirect violence and has fortunately ended in recovery.

One case of alleged injury to the innominate artery leading to the development of an innominate aneurism. It is more than probable that the aneurism existed prior to, and possibly may have predisposed to the production of, the fracture.



Drawing done by my clinical clerk, Mr. A. N. Crawford, from a dissection made by Professor Fraser, Professor of Anatomy, Royal College of Surgeons, Ireland.

Four cases of injury to the subclavian vein.

Two cases of injury to the internal jugular vein.

One case of aneurism of the acromioclavicular axis of arteries and five cases of wound of the lung associated with emphysema.

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